REMARKS

These comments are responsive to the Official Action mailed on April 19, 2006, and for which a two-month extension is hereby requested. The Office Action was stated to be final; however, it is believed that the finality was improper as the Office Action introduced new grounds of rejection for original claims. A Petition to reconsider finality has been submitted on June 15, 2006, and describes in more detail why the finality is thought improper. In any case, it is respectfully requested that the present Amendment be entered. The pending claims are unchanged except for claims 5, 7, and 10-12 that are being cancelled, leaving claims 1-4, 24, and 25 as the pending claims. Although believed allowable in their original form, claims 1 and 24 have been amended to more clearly delineate their distinctions from the prior art.

The Office Action rejected claims 1-3 under 35 U.S.C. § 102(b) as being anticipated by Fossum et al. (Pat. No. 5,841,126), rejected dependent claim 4 under 35 U.S.C. § 103(a) with Fossum et al. as the primary reference, and rejected claims 24 and 25 under 35 U.S.C. § 102(b) as being anticipated by Tsang et al. (Pat. No. 5,900,623). For the reasons given below, it is respectfully submitted that these rejections are not well founded and should be withdrawn.

Rejections based on Fossum

Claims 1-3 are rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,841,126 to Fossum et al. ("Fossum"), with dependent claim 4 rejected under 35 U.S.C. § 103(a) with Fossum as the primary reference. It is respectfully submitted that these claims present an aspect of the present invention that is not found in Fossum nor, as far as is known, found elsewhere in the prior.

More specifically, CMOS-type image sensors may use correlated double sampling to reduce the amount fixed pattern noise. As such correlated double sampling is performed in the prior art, it is prone to the phenomenon of image inversion when the light level becomes too bright. The application describes this generally in paragraph [0003], with a more detailed description of the mechanism involved given with respect to Figures 2-4 and beginning at paragraph [0025]. As described there in more detail, line 229 of Figure 2 shows the waveform of the output level for a column of pixels. This value is reset when line 211 goes high, after which an expose interval begins. During the exposure interval, the level of the output signal discharges from the level at 250 to one of the levels 260A, B, or C, where the more light incident on the

pixel, the greater the amount of discharge. The level 260 is read when the line 213 goes high. The correlated double sampling is performed by subtracting the initial value of 250 from line 229X that follows the subsequent reset. The value of 250 for the discharge 229X is read when the line at 214 goes high (just after reset) subsequent to 213 going high (prior to reset). The correlated double sampling is done by subtracting out the initial value of 250 (from 229X) from the value of 260 (from one of 229 A, B, or C).

When exposed to light intense enough to lead to saturation, such as shown in waveforms 229J or K of Figure 3, the output signal bottoms out at 260J. A problem with prior art implementation of correlated double sampling that the present invention addresses is that when this light level is extreme enough, once the pixel is exposed the waveform 229 can fall rapidly enough that the value measured for 250 (when 214 goes high) no longer accurately corresponds to the correct reset value. Instead, it will have already fallen enough so that when the correlated double sampling is performed, even though the pixel *is* saturated, it will no longer register as saturated, since it is the *difference* between 250 and 260 that is output.

This situation is described with respect to Figure 4: if the light is sufficiently intense, rather than register the value 250K (the accurate reset value corresponding to 403), the signal will fall to a value of 250Z. Consequently, when the erroneous value of 250Z is subtracted off of the preceding sample, rather than give an output corresponding to a saturated level, it will instead indicate that the photo sensor has discharged less, making the pixel appear to correspond to a darker area. Although Fossum describes the use of correlated double sampling, it is believed that it neither describes this particular problem nor presents a solution. In particular, it is respectfully submitted that the process of claim 1 is neither taught nor suggested by Fossum.

Claim 1 (as amended) states:

> A method for image sensing comprising the acts of:
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> producing, from a photo detector, a plurality of detected electronic signals responsive to an optical image;
>
> amplifying, with a column buffer amplifier, signals selected from the detected electronic signals to produce a plurality of amplified signals;
>
> sampling, with a correlated double sampler, signals selected from the amplified signals to produce a plurality of sampled signals;
>
> and
>
> clamping, by a clamp circuit, at least one signal selected from the sampled signals in response to a detecting of at least one over-saturation condition;
>
> whereby image inversion is at least partially abated.

The acts of "producing ...", "amplifying ...", and "sampling ..." relate to the correlated double sampling process. The Office Action correct in so far as Fossum discloses correlated double sampling. As noted in the Background of the application, correlated double sampling is known in the art; however, it is believed that the last element of claim 1 is neither taught nor suggested by Fossum.

With respect to the last act of "clamping ...", the Office Action cites Fossum at column 6, line 38, to column 7, line 37, and at column 8, lines 27-44. This is believed to be incorrect for a number of reasons. Column 6, line 38, to column 7, line 37, describes (see column 6, lines 24-25) the use of "an improved version of ... double delta sampling [DDS] circuitry." As described beginning at line 46 of column 6, the "object of the [DDS circuit] is to remove that source follower threshold component"; that is, the entire cited passage of column 6, line 38, to column 7, line 37, relates to producing a more accurate sample by differencing out various transistor threshold voltages. Later, starting at line 49 of column 6, Fossum does describe the use of "clamp transistors"; however, this is just referring to the transistors through which the capacitors are charged *during the reset* process. Note that at line 49, this is described as occurring "[p]rior to the beginning of some operation" to precharge the capacitors and that this is completed before the exposure period of the pixel. It should also be noted that this occurs as part of the standard rest process and occurs every cycle.

Consequently, as indicated particularly with respect to the elements with the added emphases, the last act of claim 1 contains a number of elements not found in, and not suggested by, Fossum:

> clamping, by a clamp circuit, at least *one signal selected from the sampled signals* *<u>in response to a detecting of at least one over-saturation condition</u>*;
> *whereby image inversion is at least partially abated.*

First, the "clamp transistors" are used to set the reset level, not for "clamping ... at least *one signal selected from the sampled signals*". Additionally, as noted at column 6, lines 46-49, the cited process of Fossum is for removing sample error due to the introduction of various transistor thresholds: Fossum neither teaches nor suggests a process "*whereby image inversion is at least partially abated*" and is silent on the subject of image inversion. Further, and in some ways perhaps more basically, the cited process in Fossum is just the standard operation of the circuitry given there and is performed at every cycle as a matter of course; this operation is not in response to detecting anything and, specifically is *not* "*<u>in response to a detecting of at least one</u>*

over-saturation condition" and is not a "selected signal". Fossum does not describe, and the Office Action provides no explanation of, how any of the cited material relates to either over-saturation or the abatement of its consequences.

In addition to being incorrect, it is respectfully submitted the Office Action's rejection is improper: In the Response to Arguments section in the last line on page 2, the Office Action states that Fossum "inherently teaches the final step of clamping" without providing any evidence of this or further explanation. It is respectfully submitted that improper assumptions have been made without any support evidence being provided and that the rejection is consequently improperly made.

Consequently, for at least these reasons, it is respectfully submitted that a rejection of claim 1 along with dependent claims 2-4 based on Fossum is not well founded and should be withdrawn.

Rejections based on Tsang

Claims 24-25 are rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,900,623 to Tsang et al. ("Tsang"). The Office Action is correct in the Tsang also includes a CMOS sensor that uses correlated double sampling; however, it is respectfully submitted that Tsang neither teaches nor suggests the aspects of the present invention to which claims 24 and 25 are drawn. In particular, the cited portions upon which the Office Action is relying for its rejection of the elements of claim 24 are just a description of the reset process of Tsang, which does not disclose the improvements of the present invention, such as those described above.

More specifically, claim 24 (as amended and where the emphasis is added) is:

> In an image sensor that correlates a first sample of a first signal during a first interval after reset of a photo detector and a second sample of the first signal during a later interval in the same sampling cycle as the first interval to produce a luminance signal, a method for abating an *error in the luminance signal due to excessively rapid slewing of the first signal* during the first interval wherein the improvement comprises:
>
> *detecting* that the *first signal* is slewing excessively rapidly during the first interval; and
>
> limiting the value of the *first sample*;
>
> whereby the image sensor produces an output of improved accuracy.

For the production of a luminance signal, the Office Action cites Tsang at column 7, lines 28-67, which does describe such a process; however, it is for other elements of this claim, particularly where indicated by the added emphasis, that it is believed that the rejection is not well-founded.

The first element of claim 24 (again with added emphasis) is:

> *detecting* that the *first signal* is slewing excessively rapidly during the first interval;

for which the Office Action cites Tsang at column 10, lines 5-38. More specifically, in it Response to Arguments portion, the Office Action refers to lines 5-17 of this passage. However, what this passage is describing is the reset process of in Tsang's device, where, *after* an integration period, the level at the node ST in Tsang's Figure 4 is reset to the level VRST *prior to starting* the next integration period. What is described, particularly at lines 5-17, is that device operation can be improved by resetting this value more rapidly and by resetting it to a higher level. (The use of a charge pump is suggested.) This is not the detecting of anything: it is merely a statement of how the reset mechanism works in Tsang. Further, what is being changed is not the "first signal during a first interval after reset"; rather, it is the level that is reset *during* the reset process (and is actually what the reset is resetting).

The second element of claim 24 is:

> limiting the value of the *first sample*;

where the emphasis is added again and for which the Office Action cites Tsang at column 10, lines 18-24. What is described in these lines is "clamping the reverse-biased voltage across the photodiode [PD, Tsang's Figure 4]"; however, this is again being done *during* the reset process to avoid charge overflowing when the node ST in Tsang's Figure 4 is reset to the level VRST. This not "limiting the value of the *first sample*" where, as defined in the preamble of the claim, the "first sample" is "of a first signal during a first interval *after* reset", where the emphasis is again added.

Further, as noted at Tsang's column 10, lines 18-21, "blooming refers to bright spots on the display caused by large currents generated when the photodiode PD is momentarily forward biased" and is a problem that occurs *during* reset when charges overflows into adjoining pixels making them appear *brighter* than this should be. Thus, the described anti-blooming is for an error that may occur during reset, and is not "for abating an error in the luminance signal due to excessively rapid slewing *of the first signal during the first interval*" as the "first interval" of the claim is defined to be "*after* reset of a photo detector", where the emphasis is added.

Concerning claim 25, this adds the limitation of "wherein: the error is an image inversion due to over-saturation." As noted in the quoted passage in the last paragraph, blooming leads to *bright spots* due undesired charge overflow. This is in contrast to an error due to "an image

inversion due to over-saturation", which leads to the sort of spurious *dark* central area that may appear in the middle of a bright region, as described at lines 1-5 of page 2 of the present application. Although both relate to problems resulting from saturation, blooming causes adjacent pixels to be represented as too bright, as opposed to an image inversion where a saturated, or near saturated, pixel is represented as too dark.

Consequently, for at least these reasons, it is respectfully submitted that a rejection of claim 24 along with dependent claim 25 under 35 U.S.C. § 102(b) as being anticipated by Tsang is not well founded and should be withdrawn.

Conclusion

Accordingly, it is believed that this application is now in condition for allowance and an early indication of its allowance is solicited. However, if the Examiner has any further matters that need to be resolved, a telephone call to the undersigned at 415-318-1166 would be appreciated.

Respectfully submitted,

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